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Astron.
*Sixtieth Annual Report of the Visitors of
the University Observatory for 1934.*
Oxford.

BOARD OF VISITORS, 1935.

THE VICE-CHANCELLOR (Rev. F. J. Lys, M.A., Provost of Worcester).

THE SENIOR PROCTOR (G. D. Parkes, B.Sc., M.A., D.Phil., Keble).

THE JUNIOR PROCTOR (W. F. R. Hardie, M.A., Corpus Christi).

THE ASTRONOMER ROYAL (H. Spencer Jones, M.A., F.R.S.).

THE DIRECTOR OF THE CAMBRIDGE OBSERVATORY (Sir A. S. Eddington,
Hon. D.Sc., F.R.S.).

THE RADCLIFFE OBSERVER (H. Knox-Shaw, M.A., D.Sc., Trinity).

T. W. CHAUNDY, M.A., Student of Christ Church.

G. M. B. DOBSON, M.A., D.Sc., F.R.S., Lincoln, Reader } Until Oct., 1935.
in Meteorology.

J. S. E. TOWNSEND, M.A., F.R.S., Fellow of New College. }

F. A. LINDEMANN, M.A., F.R.S., Fellow of Wadham } Until Oct., 1940.
and Student of Christ Church.

This report refers to the calendar year 1934.

I. Staff.

The permanent staff of the Observatory remains unchanged. As Research Associates Dr. H. Zanstra of the University of Amsterdam and Dr. P. ten Bruggencate of the University of Greifswald worked at the Observatory for approximately two months each. Dr. R. V. Jones was appointed by Balliol College to the first Skynner Senior Studentship in Astronomy, and graduate research in astrophysics was also undertaken by Messrs. J. D. Babbitt, I. A. Getting, and T. L. Page. It is a pleasure to record the award by the University in January of an Honorary M.A. degree to Miss E. F. Bellamy in recognition of her services to the Observatory both in astronomy and seismology.

II. Instruction.

Lectures on Astrophysics by the Director, and instruction in Ancient Astronomy and Chronology, as well as a Public Lecture on the Rotation of the Earth, by Dr. Fotheringham, have been

given during the year. With the collaboration of Professor Milne a colloquium on Astrophysics was held at the Observatory weekly during the Michaelmas Term; a series of informal discussions was also held during the Long Vacation. Apart from this advanced work the Observatory was open on clear Saturday evenings during the Hilary and Michaelmas Terms to members of the University, and at other times by special arrangement to various bodies; as a result over 200 visitors have used the twelve-inch telescope during the year.

III. Building and Equipment.

By a Decree of Congregation of 6 February the Observatory was authorized to spend £300 in making structural alterations to accommodate the new solar telescope and spectroscope in the east tower and basement of the existing building. This work has been very satisfactorily carried out, thanks in no small measure to Mr. G. Neale who both assisted in drawing up the plans and also acted as clerk of works during these extensive alterations. With the permission of the Board the De la Rue Telescope, formerly installed in this east tower and now only of historic interest, was presented to the Lewis Evans Collection.

The new solar telescope was completed by Sir Howard Grubb, Parsons & Co. early in December. Preliminary tests of the optical and mechanical performance made at their works in Newcastle were sufficiently satisfactory to allow of the instrument being installed in Oxford for final tests and use. The installation will be completed early in the New Year. The large optical parts of the spectroscope were completed by Adam Hilger, Ltd., early in November, and after some preliminary tests in their constant-temperature enclosure the prisms and objective were sent to Oxford for definitive tests in the new tunnel. The mechanical parts of the spectroscope will be made by Casella & Co. of London when and as funds permit.

IV. Work.

Astrophysics. The Director completed a series of exhaustive tests of the new microphotometer which not only revealed the

origin of a periodic error in the recording system, but also led to a general discussion of the resolving power of microphotometers. This error was corrected by the makers, and during the latter part of the year the instrument has been in almost continuous use on various problems where its accuracy of drive and high resolving power have made it invaluable. Work was also continued on the surface brightness of the sun as a function of wave-length and position, some 70 spectra being obtained in the summer on the exceptionally transparent days needed for this work.

Dr. H. Zanstra completed an investigation of the effect of radiation pressure in nebulae. He was able to show that radiation pressure due to the absorption of the first line of the Lyman series would lead to a catastrophic disintegration of a static nebula, but that in a nebula expanding with a velocity increasing with increase of distance from the exciting star this radiation pressure would become negligible. This problem has the closest bearing on the question of the origin of the planetary nebulae, and of their dynamical equilibrium.

Dr. R. V. Jones, the Skykker Senior Student, will make a study of the solar spectrum in the relatively unexplored region between wave-lengths 10,000 Å. and 20,000 Å. He will determine wave-lengths, total intensities, and identifications of the absorption lines in this region with special reference to the early members of the Paschen series. The design of a fast concave-grating spectroscope for use with the new solar telescope has been completed, and the various immediately necessary parts of the instrument either purchased or obtained on loan. The great bulk of Dr. Jones's time so far, however, has been spent in further work at the Clarendon Laboratory on the design and construction of sensitive thermocouples, bolometers, and photo-cell relays.

Dr. P. ten Bruggencate worked on the problem of late-type variables and on some questions in stellar statistics. Mr. J. D. Babbitt is engaged in a detailed study of the spectrum of Vega ; he has already determined accurate wave-lengths for over 100 lines in its spectrum, nearly all of which have been identified,

and is now determining the total absorptions and profiles of the hydrogen and metallic lines. One result of this study will be a definitive determination of the ratio of the atomic abundance of hydrogen to that of the metallic elements in this typical stellar atmosphere, a ratio at present uncertainly estimated to lie somewhere between 14 and 1,000 to one.

Following the lines suggested by Professor Milne, Mr. I. A. Getting has completed a study of the characteristic curves of Cepheids, RV Tauri, and late-type variables. As a result he has been able to make the first determination of the range of effective and brightness temperatures in these variables, and he has also been able to show how such variables may be accurately classified from the shape and mode of description of their characteristic curves. In addition he has continued his work on attempts to photograph the interstellar calcium clouds by means of their infra-red radiation. Mr. T. L. Page has commenced an investigation on the continuous and line spectra of various planetary nebulae. From the intensity distribution of the visible continuous spectrum he will be able to determine whether it originates in a Paschen continuous spectrum, or simply by reflection of star light from foreign particles in the nebula; from the intensity distribution in the ultra-violet Balmer continuous spectrum he will be able to make the first direct determinations of electron temperatures in nebulae.

Astrographic Catalogue. Work on the Potsdam zones $+32^\circ$ and $+33^\circ$, as the following table shows, is going forward most satisfactorily. Two features of this table are especially to be noted. In the first place Mr. F. A. Bellamy has succeeded in

Plates.	Obtained.		Measured.		Reduced.	
	$+32^\circ$	$+33^\circ$	$+32^\circ$	$+33^\circ$	$+32^\circ$	$+33^\circ$
Before 1932 .	61	1	24	0	24	0
In 1932 .	14	3	34	0	34	0
In 1933 .	26	34	32	11	32	11
In 1934 .	79	124	48	57	48	57
Total .	180	162	138	68	138	68

Average number of stars per plate = 414.

obtaining with a telescope, which yearly becomes more difficult to use for work of the highest quality, a very large proportion of the plates needed to complete the two zones. Making allowance for plates which will have to be rejected on account of the quality or the number of the images, he estimates that only 12 plates are needed to complete the observation of zone $+32^\circ$, and 47 to complete zone $+33^\circ$. In the second place it will be noted that there is a marked increase in the number of plates measured and reduced during the year. This is partly due to an increase in the number measured by Mr. Cook, and partly to the fact that some outside assistance has been secured. Because of interest in Professor Turner's work, stimulated afresh by a lecture given by Mr. Bellamy in Newcastle at the close of 1933, Dr. Wilfred Hall of Tynemouth undertook to provide for the measurement of these astrographic plates up to a certain maximum number. An arrangement has been made whereby Mr. A. Burnet, a measurer formerly employed at the Observatory, is engaged by Dr. Hall to do the measuring on a micrometer loaned by the Observatory. Thanks to this generosity of Dr. Hall, 44 plates have been satisfactorily measured during the year by Mr. Burnet. To summarize, the observational work on the two zones is 81 per cent complete, the measurement and reduction 64 per cent complete.

Reader in Ancient Astronomy. Dr. J. K. Fotheringham has continued to act as Honorary Assistant. In addition to his work on Ancient Astronomy and Chronology he has prepared a revised and enlarged account of the Calendar for the 1935 edition of the *Nautical Almanac*. From a discussion of observations of the Sun and Mars over the past century he has found certain anomalies which, whatever their physical interpretation, may be represented as small variations in the mass of Venus. This investigation, nearly completed, confirms and extends his previous work on this subject.

Seismology. Mr. J. S. Hughes and Miss E. F. Bellamy, with some computational assistance from Mr. Cook, have determined epicentres and station residuals for the earthquakes of 1930.

The first two quarterly issues of the *International Seismological Summary* for this year have been prepared for the press, printed, and distributed, the third quarter has been printed, and the fourth is now going to press. In addition, Mr. Hughes has prepared an account of his methods of determining epicentres, especially as modified by the use of the new Travel-Time Tables of Jeffreys and Bullen, and this has been published as an Introduction to the *Summary* for the year 1930. Apart from some not readily traceable trouble due to friction in an agate cup of a mirror support, the two Milne-Shaw seismographs have been in continuous operation throughout the year and have recorded over 150 earthquakes.

V. Publications.

The following papers have been published during the year, either as a result of work done at the Observatory, or by members of its staff:

- I. A. GETTING. "The Characteristic Curves of Some Variable Stars", *Monthly Notices R.A.S.*, vol. 95, December, 1934.
- J. S. HUGHES. *Introduction to the International Seismological Summary for 1930* (I.W. County Press, 1934).
- J. S. HUGHES and E. F. BELLAMY. *The International Seismological Summary for 1930* (The first three quarters).
- H. H. PLASKETT. "A Moll-Type Microphotometer and its Performance", *Monthly Notices R.A.S.*, vol. 95, December, 1934.
- H. ZANSTRA. "Radiation Pressure in an Expanding Nebula", *Monthly Notices R.A.S.*, vol. 95, December, 1934.

The first, fourth, and fifth papers in this list will appear in their reprint form in the new astrophysical series "Communications from the University Observatory, Oxford, Nos. 2, 3, and 4".

VI. Miscellaneous.

The following astronomers, amongst others, have visited the Observatory for periods of varying length during the year: Professor E. W. Brown of Yale, Dr. Theodore Dunham, Junior, of Pasadena, Mr. John Evershed of Ewhurst, Dr. Edwin Hubble

of Pasadena (The Halley Lecturer for 1934), Professor S. Rosse-land of Oslo, and Professor Harlow Shapley of Harvard.

In addition to the usual astronomical and seismological publications regularly received during the year, the Radcliffe Science Library presented two duplicate works of Knobel, and the Radcliffe Observatory presented a number of valuable seismological works to the Milne Library.

H. H. PLASKETT.

UNIVERSITY OBSERVATORY,
OXFORD.

January 10, 1935.

